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A study on the physico-chemical parameters of Thodupuzha River, Idukki district

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ABSTRACT

Quality of water is an important criterion for evaluating the suitability of water for irrigation and drinking. This paper deals with the study of physico-chemical parameters of water in four different sites of Thodupuzha River in Idukki district. The study was conducted in the monsoon season of 2014. The samples of water were collected using standard methods. The physico-chemical analysis was extensively carried out on each sample using known standard methods. In the present study the concentration of all the parameters in station 1 were found within the permissible limit as prescribed by BIS standard. The concentrations of nutrients were also found within the BIS standard limit. But in other three stations, the rates of nutrients were high comparing with that of station 1. The study might be a reminder for the need of restoration of the degraded water quality of the river. This will create awareness among people to improve the water quality status and the need for the conservation of these natural resources.

Key words: Physico-chemical parameters, nutrients, eutrophication etc.

1. INTRODUCTION

Rivers are important sources of water for households, industry and agriculture. They are also valued for recreational use and nature conservation. Water, by means of its physical, chemical and biological characteristics, reflects the significance as potent ecological factor and quality for sustenance. However, the increasing anthropogenic influences in recent years, in and around aquatic ecosystem and their catchment areas have contributed to a large extent to various nutrient enrichment which leads to deterioration of the water quality. The increasing trend of nutrient enrichment in the system accelerates eutrophication and growth of many aquatic organisms, which exerts a great surge to the ecosystem of many fresh water bodies. The very source of potable water contains both micro and macro nutrients in permissible limit but quality of drinking water changes due to human interference and get contaminated through percolation and seepage, drains and domestic sewage (Pandey and Kumar, 1995).

Now-a-days due to rapid industrialization and human population growth most of the Indian rivers are polluted (Sahu, 1991). The physico-chemical characteristics are also greatly affected due to discharge of domestic, municipal, industrial and other several factors like religious offerings, recreational and constructional activities in the catchments areas (Panda, 1991). Hill and Webb (1958) reported that rainfall pattern influences in changing the physical and chemical environment of water and helps in increasing input of pollutants. Thus, necessary knowledge of the water quality for framing, restoration and management could result only after determining the distribution patterns of ever increasing enrichment of nutrients.

The present study involves the analysis of water quality in terms of physico – chemical parameters of four different sites of Thodupuzha River in monsoon season. On the view out of the four sites two getting degraded due to the dumping of industrial and agricultural effluents and domestic sewage in an in an uncontrolled manner . The remaining two are partially or completely pure for different purpose. The main objective of this study is to identify the water quality parameters. The study might be a reminder for the need of restoration of the degraded water quality of the River. This will create awareness among people to improve the water quality status and the need for the conservation of these natural resources.

2. MATERIALS AND METHODS

The present study was conducted during the monsoon season, and the water samples were collected from four different sites of Thodupuzha river of Idukki district. Four water samples were collected in clean polythene bottles and are brought to the laboratory. The hydrographical parameters such as water temperature, pH, Dissolved oxygen, carbondioxide, chloride, fluoride, nitrate, nitrite, ammonium, phosphate,iron,total hardness and transparency were analyzed following standard methods. The samples were collected in monsoon season of 2014. The data was recorded from four different sites of Thodupuzha River based on local importance and the nature of difference and trend in variations in the water quality parameters.

FOUR SELECTED STATIONS OF THODUPUZHA RIVER

Station 1

Station 2

Station 3

Station 4

3. RESULTS AND DISCUSSION

In the present study the concentration of all parameters were not in permissible limit except in station 1, as prescribed by BIS standard. Study concerns about river water quality and are directly related to the use of the river. As with all river management decisions, consider the primary uses of the river to determine which water quality parameters are of greatest concern. The river water temperature is a dynamic parameter, which is formed by the geophysical and climatic characteristics of the watershed and by the natural hydrological processes of formation and propagation of the runoff. In this study it ranged from 27 to 29.52 ^{0}C (Table 1). All metabolic and physiological activities of the aquatic organisms are greatly influenced by water temperature. A degree of variation in the temperature of the water body has great bearing up on its productivity potential also. The variation recorded in present study was not very great and as such it could not bring out any drastic fluctuation in the dynamics of the pond ecosystem of water study. In present study the pH ranged from 4.02 to 7.01. Station 1 is nearly neutral and Nitrogen and sulfuric emissions come from natural and anthropogenic sources. Natural emissions include e.g. volcano emissions, lightning, and microbial processes. While others are acidic because of pH less than 6. Acid deposition influences mainly the pH of freshwater. Acid deposition has many harmful ecological effects when the pH of most aquatic systems falls below 6 and especially below 5. Aluminium ions (Al^{3+}) attached to minerals in nearby soil can be released into lakes, where they can kill many kinds of fish by stimulating excessive mucus formation. This asphyxiates the fish by clogging their gills. It can also cause chronic stress that may not kill individual fish, but leads to lower body weight and smaller size and makes fish less able to compete for food and habitat. The higher pH values observed suggests that carbon dioxide, carbonate-bicarbonate equilibrium is affected more due to change in physico-chemical condition (Karanth, 1987).

In this study the dissolved oxygen ranged from 3.01 to 5.20 mg/l. The oxygen dissolved in lakes, rivers, and oceans is crucial for the organisms and creatures living in it. Dissolved oxygen can affect the solubility and availability of nutrients, which can be released from sediments under conditions of low dissolved oxygen (MELP, 1998). In this study amount of CO_2 is 2.9 (mg/l) in station 1. All other station it is higher than 12 (mg/l).All plants and animals eventually die and decompose. Microorganisms play a major role in the decomposition process.

The amount of chloride ranges from 1.01 to 4mg/l. Chloride ions are conservative, which means that they are not degraded in the environment and tend to remain in solution, once dissolved. Fluoride is absent in station 1. Fluoride ions are directly toxic to aquatic life, and accumulate in the tissues, at concentrations where absorption rates exceed excretion rates. Some accumulation occurs in all tissues, but in most tissues subsequent losses may occur when ambient fluoride levels decrease. However, in bone, tooth and scales, accumulation is permanent and cumulative.Larger fish are more tolerant of higher fluoride levels and accumulate

less fluoride on a per weight basis (Hemens, 1975).Nitrate is not utilized by aquatic organisms such as fish and aquatic insects, but nitrates are used by aquatic plants. All aquatic organisms excrete wastes and aquatic plants and organisms eventually die. These activities create ammonia. Some bacteria in the water change this ammonia to produce nitrite which is then converted by other bacteria to nitrate. Nitrates (NO^{3-}) are an oxidized form of nitrogen and are formed by combining oxygen and nitrogen(Fig.1,2)..Although nitrates occur naturally in soil and water, an excess level of nitrates can be considered to be a contaminant of ground and surface waters. Most sources of excess nitrates come from human activity. The source of excess nitrates can usually be traced to agricultural activities, human wastes, or industrial pollution.

Ammonia absent in station 1, while present in all other stations. Ammonia makes a powerful cleaning agent when mixed with water. For this reason, it is one of the most common industrial and household chemicals. Ammonia is toxic to fish and aquatic organisms, even in very low concentrations. When levels reach 0.06 mg/L, fish can suffer gill damage. When levels reach 0.2 mg/L, sensitive fish like trout and salmon begin to die. As levels near 2.0 mg/L, even ammonia-tolerant fish like carp begin to die. Ammonia levels greater than approximately 0.1 mg/L usually indicate polluted waters.

Phosphate was high in station 4 nearly of 0.76 mg/l(Fig 3).When it rains, varying amounts of phosphates wash from farm soils into nearby waterways. Phosphates stimulate the growth of plankton and water plants that provide food for fish. This may increase the fish population and improve the waterway's quality of life. If too much phosphate is present, algae and water weeds grow wildly, choke the waterway, and use up large amounts of oxygen. Many fish and aquatic organisms may Iron comes in several forms in water. It can be dissolved in the water or so heavy that it forms precipitate or microscopic solid pieces suspended in the water. Iron is absent in station 1. While is present in other stations. At normal levels, iron is not deadly to any aquatic animals, but at higher levels when iron does not dissolve in water, fish and other creatures cannot process all the iron they take in from water or their food. The iron can build up in animals' internal organs, eventually killing them (fig 4). Higher levels of iron in fish and aquatic plants also have negative effects on the people or creatures consuming the die. Water hardness represents the total concentration of calcium and magnesium ions and is expressed as milligrams per liter (mg/L) of calcium carbonate. Hardness concentrations above 50 mg/L can reduce the effectiveness of some copper-based herbicides. In this study it ranges from 20 to 52. Hardness was high in station 4. Secchi disc transparency ranged from 32.5 to 105.5 cm. Pure water has low transparency rate but polluted water show high transparency rate.

From the result it can be concluded that the river water is highly influenced by local interactions such as agricultural areas and industrial areas. Water near the area, where there was less anthropogenic activities is less polluted and is good for irrigation and other human needs. When the river flows down words, it cover areas such as hospitals, public urinals, industries etc. then it become polluted and the amount of O_2 decreased, the water become acidic and high CO_2 and increased levels of nutrients. So the water is polluted when water flows downwards.

Table 1

Physico-chemical parameters of the selected four river sites

Sl no.	Parameters	Station 1	Station 2	Station 3	Station 4
1	TEMPERATURE(°C)	27	28	28.5	29.52
2	pH	7.01	6.01	5.21	4.02
3	DISSOLVED OXYGEN (mg/l)	5.20	4.91	4.23	3.01
4	FREE CO2 (mg/l)	2.9	12.001	12.23	13.5
5	CHLORIDE(mg/l)	1.01	3.2	3.2	4
6	FLURIDE(mg/l)	-	0.011	0.081	0.09
7	NITRATE(mg/l)	-	5.32	11.05	11.38
8	NITRITE (mg/l)	-	0.1	0.11	0.16
9	AMMONIUM(mg/l)	-	0.22	0.26	1.23
10	PHOSPHATE(mg/l)	0.001	0.59	0.71	0.76
11	IRON(mg/l)	-	0.03	0.33	0.45
12	TOTAL HARDNESS(mg/l)	12	25	35	52
13	SECCHI DISC(cm)	32.5	52	75	105.5

(-) = Absent

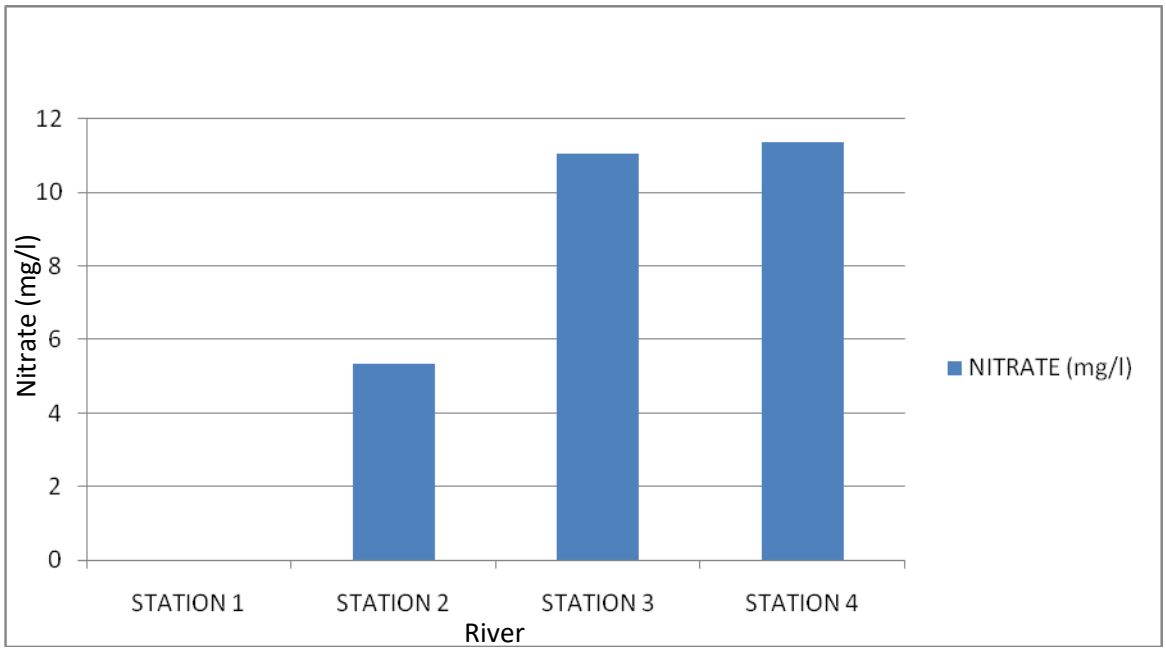

Figure 1
Variation of nitrate in four different sites

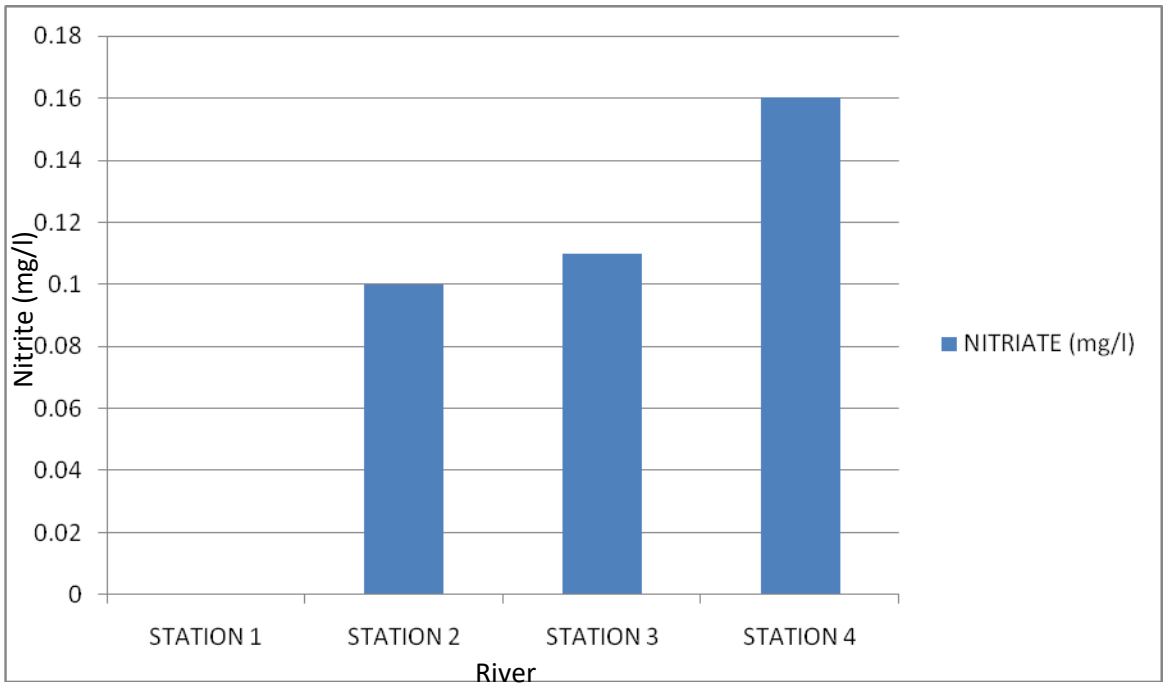

Figure 2
Variation of nitrite in four different sites

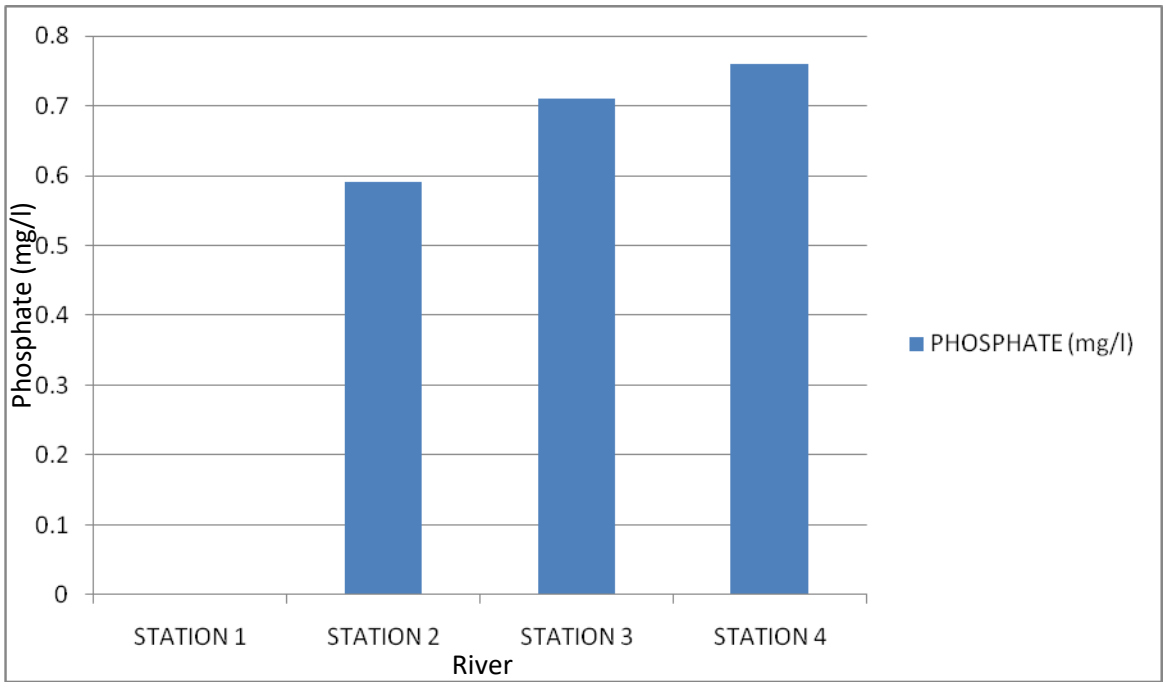

Figure 3
Variation of phosphate in four different sites

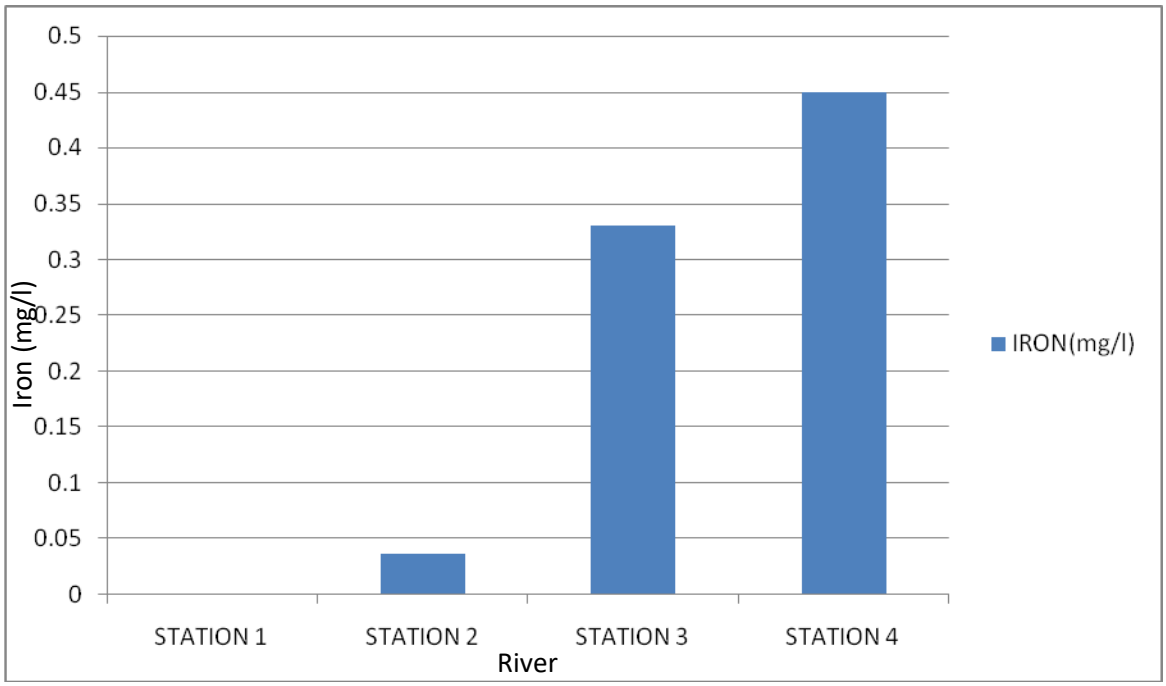

Figure 4
Variation of iron in four different sites

4. CONCLUSION

In the present study the concentration of all the parameters in station 1 were found within the permissible limit as prescribed by BIS standard. But in other stations, the rate of nutrients were high comparing with that of station 1. So it will cause eutrophication. As nutrient level rise, growth of phytoplankton is no longer nutrient-limited and algal blooms occurs .If the blooming algae produce toxic chemicals, fish kills and adverse human health effects can occur. There was no industries around the station 1, so the metals like Fe were absent. While other stations were polluted because of dumping of agricultural effluents and domestic sewages in an uncontrolled manner. The result indicated that the river is being polluted. So it is not used for drinking and irrigation purpose because it will cause eye/nose irritation, skin diseases, stomach discomfort etc due to the presence of nutrients and other parameters near the BIS standard limit. The Knowledge of water quality parameters will help aqua-culturists determine the potential of a body of water to produce aquaculture species, to maintain or to improve water quality in the culture system, to minimize problems of fish stress and fish health, to produce high quality aqua cultural products, to reduce impact of effluents, and to realize more efficient production and greater profits.

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